KA3012D

4-Channel Motor Driver

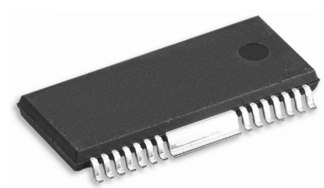
Features

- BTL (H-Bridge type linear) 4channel motor driver
- Wide dynamic range:
  - SV_{CC}=12V, PV_{CC1}=5V, R_L=8Ω → V_{OM}=4.2V
  - SV_{CC}=12V, PV_{CC2}=12V, R_L=24Ω → V_{OM}=10.4V
- Built in level-shift circuit
- Built in OP-amp for digital input
- Built in thermal shutdown (TSD) circuit
- Three independent sources
- Low crossover distortion
- Built-in reverse rotation prevented
- Built-in short breaker

Description

The KA3012D is a monolithic IC, and suitable for 4-CH motor driver which drives sled motor, loading motor, focus & tracking actuator of CD-media system and built in OP-amp which can receive digital signal from servo of CD-media system.

28-SSOPH-375



Typical Applications

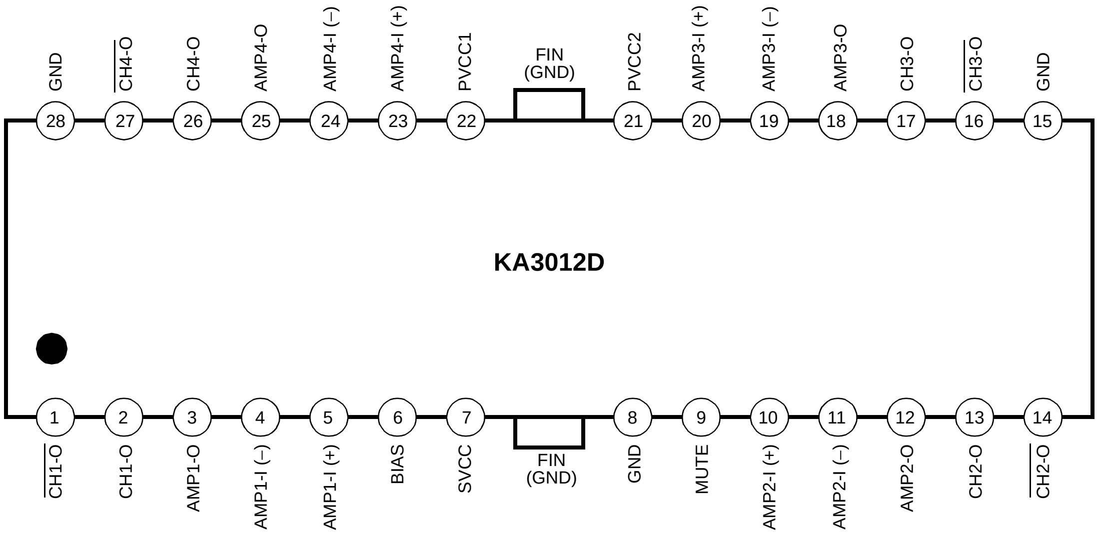
- Compact disk ROM (CD-ROM)
- Compact disk RW (CD-RW)
- Digital video disk ROM (DVD-ROM)
- Digital video disk RAM (DVD-RAM)
- Digital video disk player (DVDP)
- Other compact disk media

Ordering Information

Device	Package	Operating Temp.
KA3012D-02	28-SSOPH-375	-35 °C ~ 85 °C
KA3012D-02TF	28-SSOPH-375	-35 °C ~ 85 °C

Rev. 1.0.1
February. 2000.

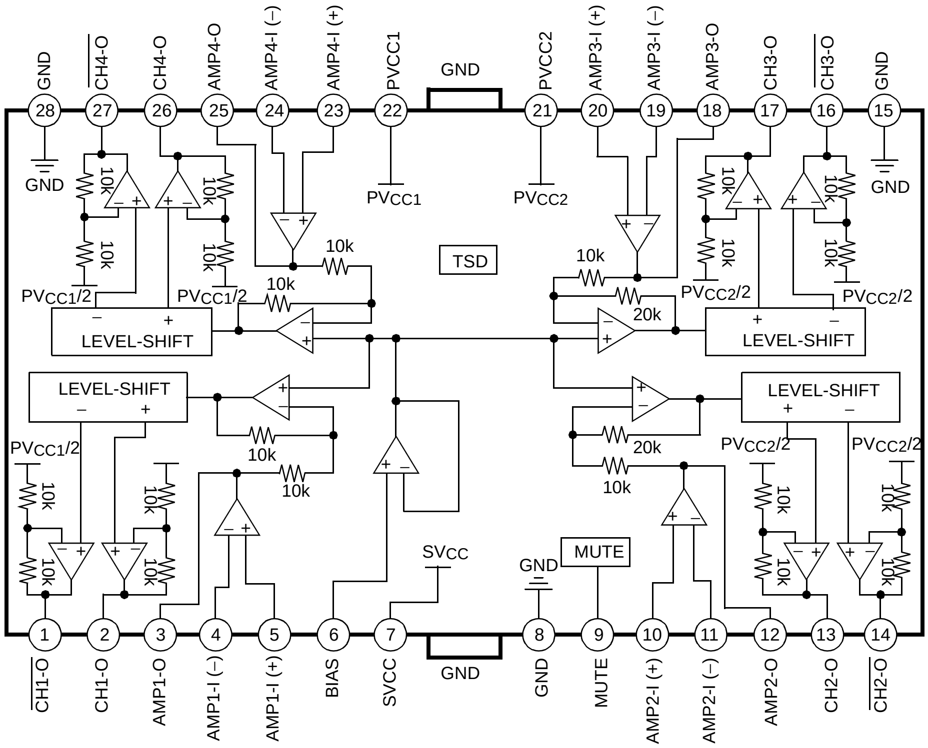
Pin Assignments



Pin Definitions

Pin Number	Pin Name	I/O	Pin Function Description
1	CH1-O	O	Drive CH 1 output (–)
2	CH1-O	O	Drive CH 1 output (+)
3	AMP1-O	O	Op-amp CH 1 output
4	AMP1-I(–)	I	Op-amp CH 1 input (–)
5	AMP1-I(+)	I	OP-amp CH 1 input (+)
6	BIAS	I	Bias input
7	SVCC	-	Supply voltage (Signal)
8	GND	-	Ground
9	MUTE	I	Mute
10	AMP2-I(+)	I	OP-amp CH 2 input (+)
11	AMP2-I(–)	I	Op-amp CH 2 input (–)
12	AMP2-O	O	Op-amp CH 2 output
13	AMP2-O	O	OP-amp CH 2 output (+)
14	CH2-O	O	Op-amp CH 2 output (Op-amp CH 2 output)
15	GND	-	Ground
16	CH3-O	O	Drive CH 3 output (–)
17	CH3-O	O	Drive CH 3 output (+)
18	AMP3-O	O	OP-amp CH 3 output
19	AMP3-I(–)	I	Drive CH 3 input (–)
20	AMP3-I(+)	I	Drive CH 3 input (+)
21	PVCC2	-	Supply voltage (CH 2 & CH 3)
22	PVCC1	-	Supply voltage (CH1 & CH 4)
23	AMP4-I(+)	I	OP-amp CH 4 input (+)
24	AMP4-I(–)	I	Op-amp CH 4 input (–)
25	AMP4-O	O	Op-amp CH 4 output
26	CH4-O	O	Drive CH 4 output (+)
27	CH4-O	O	Drive CH 4 output (–)
28	GND	-	Ground

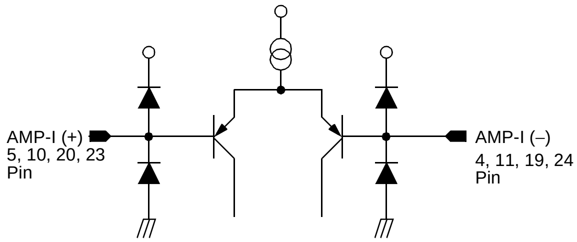
Internal Block Diagram



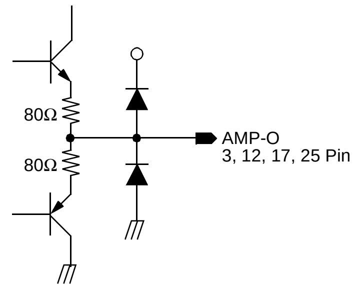
NOTE:
The drive channel outputs are determined pre OP-amp output.

Equivalent Circuits

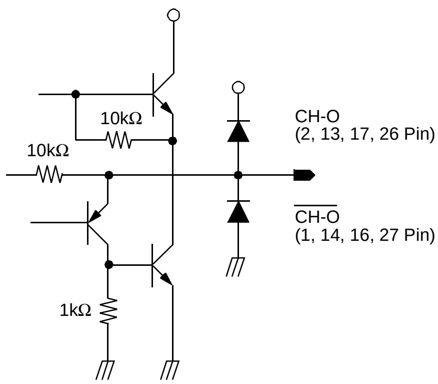
Op-amp input



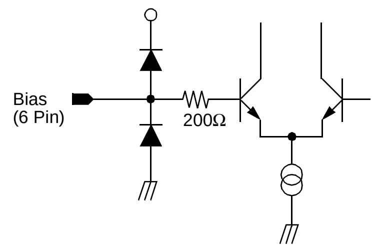
Op-amp output



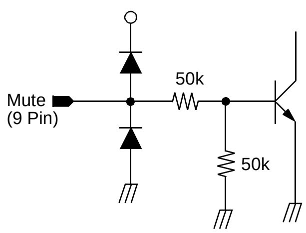
Drive output



Bias



Mute

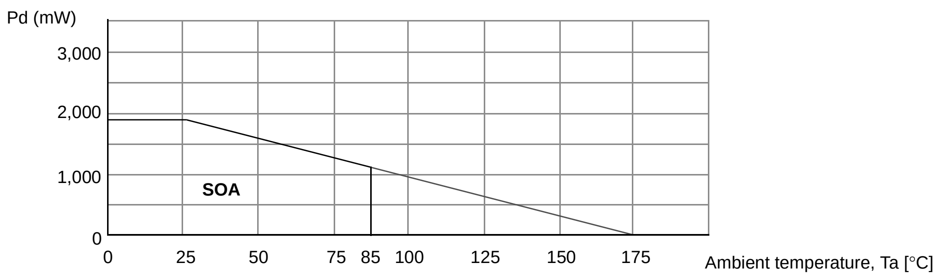


Absolute Maximum Rating (Ta = 25°C)

Parameter	Symbol	Value	Unit
Supply voltage	V_{CC}	15	V
Power dissipation	P_D	1.7[note]	W
Operating temperature range	T_{OPR}	–35 ~ +85	°C
Storage temperature range	T_{STG}	–55 ~ +150	°C

NOTE:
1. When mounted on 50mm × 50mm × 1mm PCB (Phenolic resin material).
2. Power dissipation reduces 13.6mW / °C for using above Ta=25°C.
3. Do not exceed P_D and SOA (Safe operating area).

Power Dissipation Curve



Recommended Operating Condition (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	SV_{CC}, V_{CC1}, V_{CC2}	4.5	-	13.2	V

Electrical Characteristics

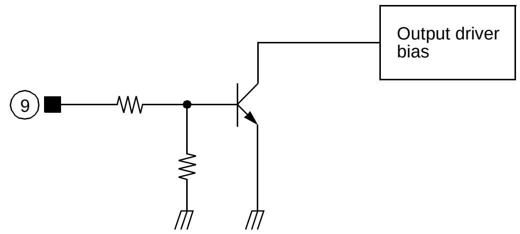
($Ta=25°C$, $V_{CC1}=V_{CC2}=5V$, $R_L=8\Omega$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
DRIVE CIRCUIT						
Quiescent current 1	I_{CC1}	No load, Mute off	-	15	20	mA
Quiescent current 2	I_{CC2}	No load, Mute on	-	-	500	uA
Output offset voltage 1	V_{OO1}	CH 1, CH 4	–70	0	70	mA
Output offset voltage 2	V_{OO2}	CH 2, CH 3	–90	-	90	mV
Max.output amplitude 1	V_{OM1}	CH 1, CH 4	3	4.2	-	V
Max.output amplitude 2	V_{OM2}	CH 2, CH 3 (RL=24Ω)	8	10.4	-	V
Voltage gain 1	G_{VC1}	$V_{IN}=0.1V_{RMS}$, 1kHz, sinewave. Input OP-amp → Buffer CH 1, CH 4	10	12.0	14	dB
Voltage gain 2	G_{VC2}	$V_{IN}=0.1V_{RMS}$, 1kHz, sinewave. Input OP-amp → Buffer CH 2, CH 3	16	18	20	dB
Mute on voltage	V_{Mon}	-	2.0	-	-	V
Mute off voltage	V_{Moff}	-	-	-	0.5	V
INPUT OP-AMP CIRCUIT						
Input offset voltage	V_{OFOP}	-	–10	0	10	mV
Input bias current	I_{BOP}	-	-	-	300	nA
High level output voltage	V_{OHOP}	-	10	10.9	-	V
Low level output voltage	V_{OLOP}	-	-	1.1	1.8	V
Output driving current sink	I_{SINK}	Input op-amp output → V_{CC} & 1.2kΩ	1	-	-	mA
Output driving current source	I_{SOURCE}	Input op-amp output → GND & 1.2kΩ	1	-	-	mA
Slew rate	SR	100kHz square-wave 2Vp-p output	-	1	-	V / µs

Application Information

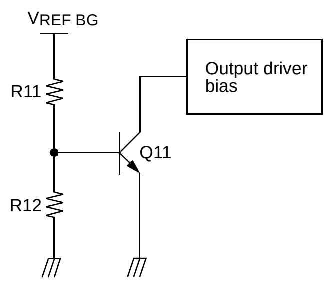
1. MUTE

Pin #9	Mute circuit
High	Turn-on
Low	Turn-off
Open	Turn-off



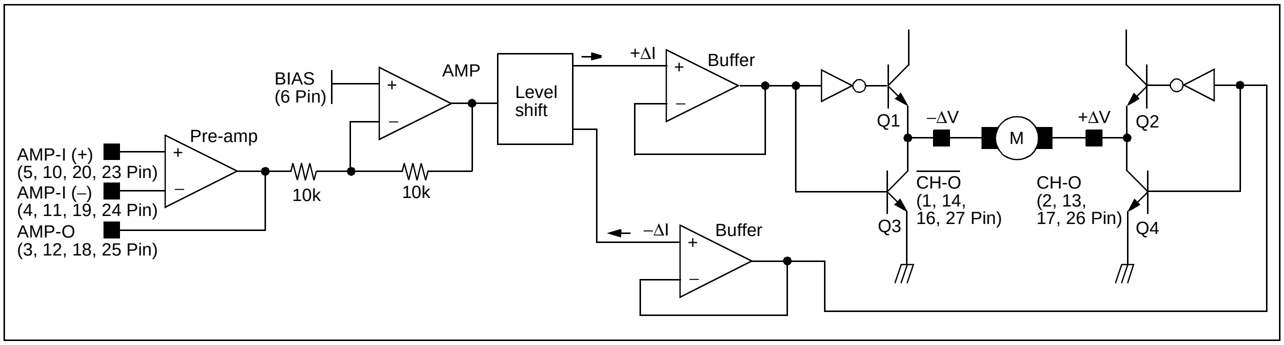
- When the voltage level of the mute pin is above 2V, the mute circuit is activated so that the output circuit will be muted.
- When the mute pin #9 is open or the voltage of the mute pin #9 is below 0.5V, the mute circuit is deactivated and the output circuit operates normally.
- When the mute circuit is activated, the voltage level of output pins becomes $1/2V_{CC}$ (approximately).

2. TSD (THERMAL SHUTDOWN)



- If the chip temperature rises above 175°C, then the TSD (Thermal shutdown) circuit is activated and the output circuit is muted.
- The $V_{REF\ BG}$ is the output voltage of the band-gap-referenced bias in circuit and acts as the input voltage of the TSD circuit.
- The base-emitter voltage of the TR,Q11 is designed to turn-on at 460mA.
  $V_{BE} = V_{REF\ BG} \times R12 / (R11 + R12) = 460mV$
- When the chip temperature rises up to 175°C, the turn-on voltage of the Q11 drops down to 460mV. (Hysteresis: 25°C) and Q11 turns on so the output circuit is muted.

3. DRIVER

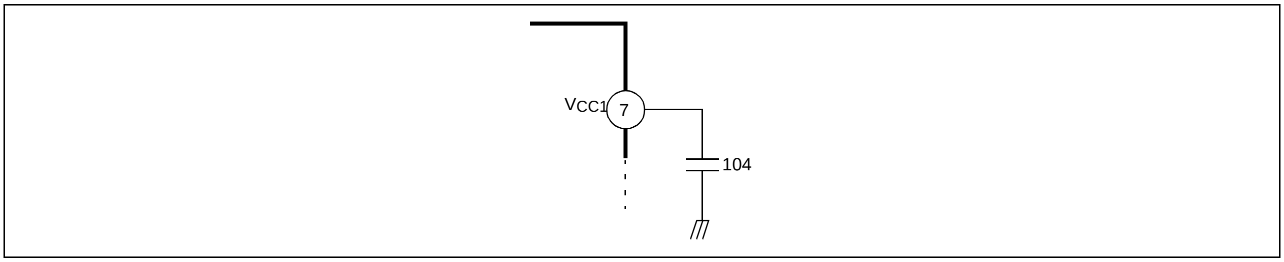


- The gain of pre-op. Amplifier can be changed by manipulating amp input resistor or feedback resistor.
- The voltage, V_{REF}, is the reference voltage given by the bias voltage of the pin #6.
- The level shift produces the current due to the difference between the pre amp output signal and the arbitrary reference (bias) signal. (The current produced as +ΔI and −ΔI is fed into the driver buffer. (CH1/CH4)
  The current produced as +2ΔI and −2ΔI is fed into the driver buffer. (CH2/CH3)
- Driver buffer drives the power TR of the output stage according to the state of the input signal.
- The output stage is the BTL driver and the motor is rotating in forward direction by operating TR Q1 and TR Q4.On the other hand, if TR Q2 and TR Q3 is operating, the motor is rotating in reverse direction.
- When the output voltage of Pre-Amp (Pin 3, 12, 18, 25) is below the V_{REF}, then the direction of the motor is in forward.
- When the output voltage of Pre-Amp (Pin 3, 12, 18, 25) is above the V_{REF}, then the direction of the motor in reverse.
- The gain (A_V) of the drive circuit is as follows.

$$A_V = 20\log\left[\frac{4V_{IN}}{V_{IN}}\right] = 12(\mathrm{dB}) \quad (\mathrm{CH1/CH4})$$

$$A_V = 20\log\left[\frac{4V_{IN}}{V_{IN}}\right] = 18(\mathrm{dB}) \quad (\mathrm{CH1/CH4})$$

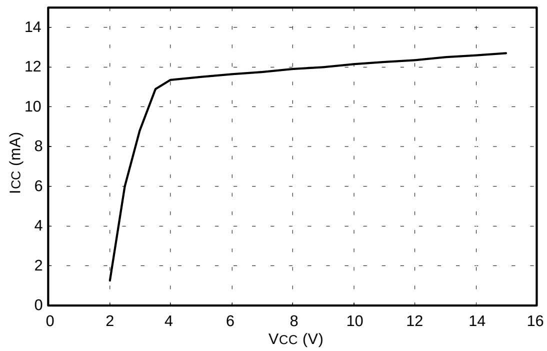
4. CONNECT A BY-PASS CAPACITOR, 0.1μF BETWEEN THE SUPPLY VOLTAGE SOURCE.



5. RADIATION FIN IS CONNECTING TO THE INTERNAL GND OF THE PACKAGE. CONNECT THE FIN TO THE EXTERNAL GND.

Typical Performance Characteristics

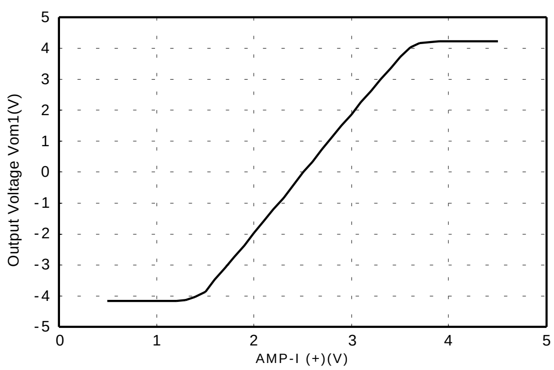
V_{CC} vs I_{CC} (No load)



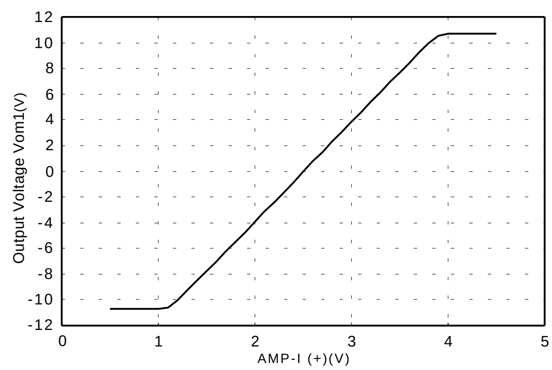
AMP-I (+) vs OUTPUT VOLTAGE

Figures can be obtained by changing of AMP-I (+) from 0V to 5V, shows the voltage difference between CH-O and CH-O. (AMP-I (+) and AMP-O are shorted.)

1. CH 1 and CH 4 (12dB)

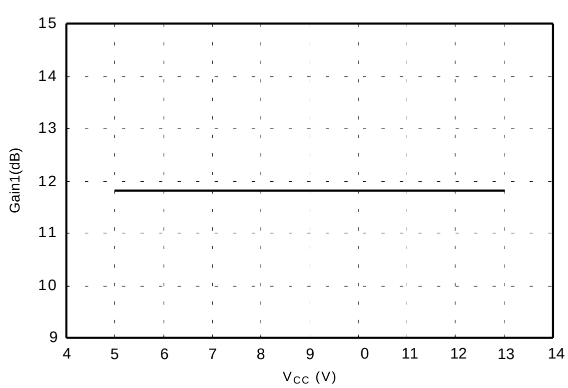


2. CH 2 and CH 3 (18dB)

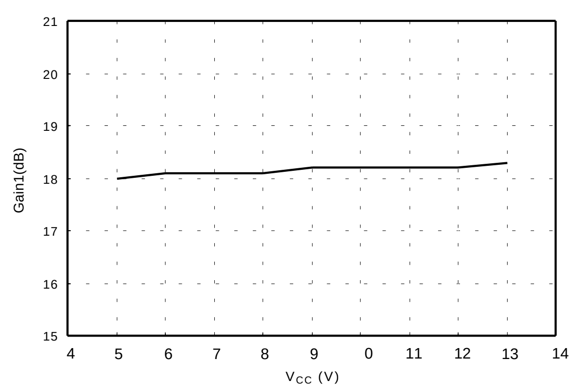


V_{CC} vs Gain

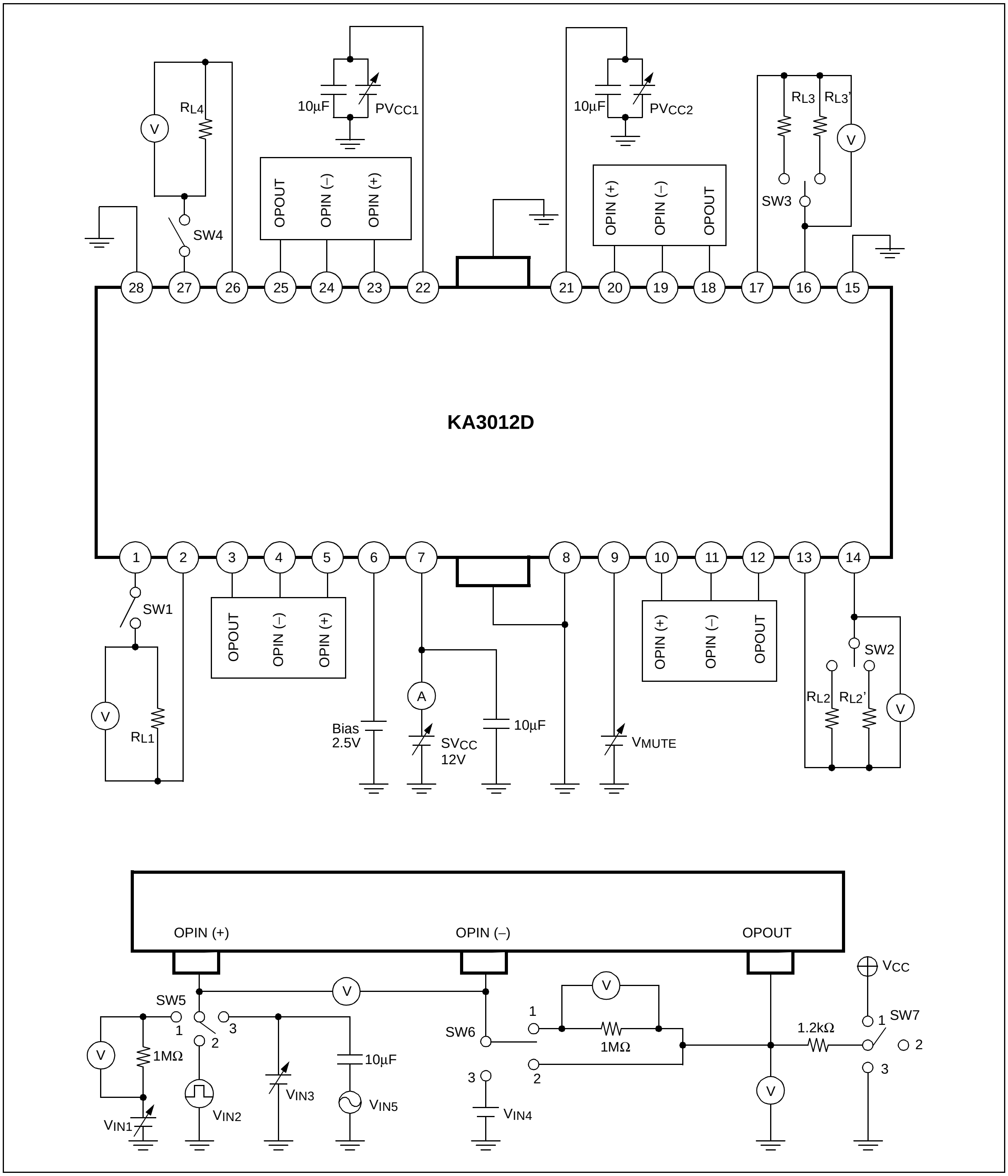
1. CH 1 and CH 4 (12dB)



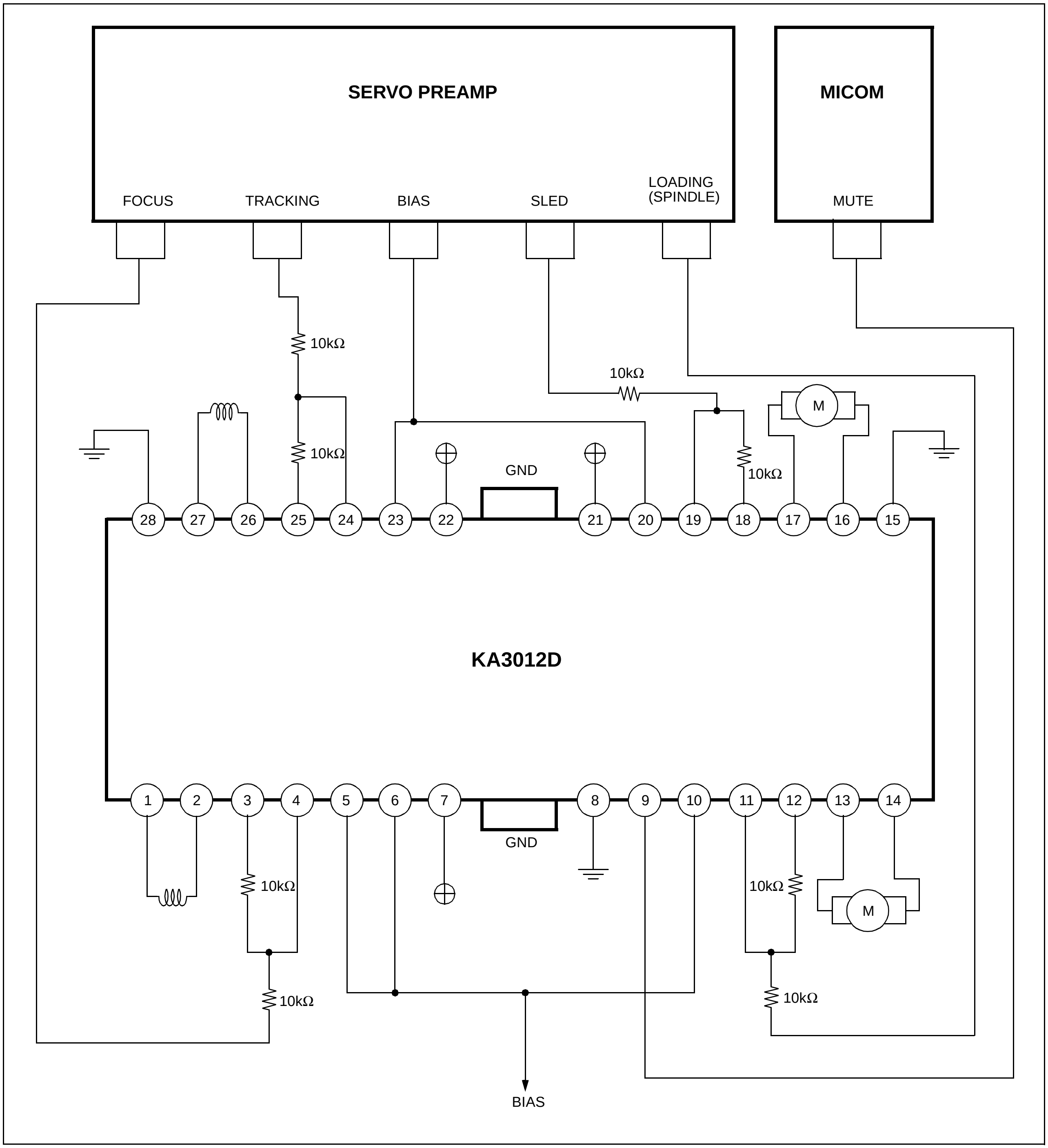
2. CH 2 and CH 3 (18dB)



Test Circuits



Typical Application Circuits



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